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FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 780.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	STARR, Donald
Examiner Name	W.D. Bray
Group Art Unit	3725
Attorney Docket No.	W141 0235

METHOD OF PAYMENT

1. ☑ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number: 02-1037

Deposit Account Name: Oyen Wiggs Green & Mutala

☑ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☑ **Payment Enclosed:**

☑ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	740	201	370	Utility filing fee	740.00
106	330	206	165	Design filing fee	
107	510	207	255	Plant filing fee	
108	740	208	370	Reissue filing fee	
114	160	214	80	Provisional filing fee	

SUBTOTAL (1) ($) 740.00

2. EXTRA CLAIM FEES

	Extra Claims		Fee from below		Fee Paid
Total Claims	8	-20** =		X	=
Independent Claims	2	- 3** =		X	=
Multiple Dependent					=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0.00

***or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,280	241	640	Petition to revive - unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40.00
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid **SUBTOTAL (3)** ($) 40.00

SUBMITTED BY

Name (Print/Type)	Gerald O.S. Oyen	Registration No. (Attorney/Agent)	27,280	Telephone	(604) 669-3432
Signature				Date	10/10/2002

Complete *(if applicable)*

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METHOD AND APPARATUS FOR SINGULATING, DEBARKING, SCANNING AND AUTOMATICALLY SAWING AND SORTING LOGS INTO LENGTHS

Ins. A1

FIELD OF THE INVENTION

This invention relates to a method and apparatus for singulating, debarking, scanning and automatically sawing and sorting logs into lengths. More particularly, this invention relates to a high product system and apparatus for processing raw logs into debarked optimum lengths for sawing into the maximum amount of lumber per log.

BACKGROUND OF THE INVENTION

For raw logs to be cost effectively processed into random lengths without bark for use in a sawmill, it is important that this process is done with speed, accurate information obtained about the log, and accurate cutting into the maximum number of usable lumber per log. The speed requirement is determined in part by the efficient singulation of the logs from a log pile into the log processing system, in part by the rate at which bark can be removed optimally, with a minimum amount of white waste, in part by the rate at which the log can be quickly and accurately positioned and cut by the saws and in part by the rapid effective removal system of the random lengths. The accuracy of the information obtained about a log is determined by the type of conveying system, the type of scanner and whether the log is scanned with bark on or bark off. The accuracy of cutting the logs into lengths is determined in part by the required log process speed and in part by the system and equipment in which the log is positioned relative to the saw.

Considerable effort has been expended over the years to develop efficient and high speed log processing systems. The prior art that has been developed includes equipment and systems disclosed in the U.S. patents listed below.

U.S. Patent No. 5,119,930, granted June 9, 1992, Stelter, discloses and protects a single quadrant-type log sorter. Stelter, in Figures 1 and 2, illustrates in dotted lines, a counterweight 70 which reduces the force necessary to raise the quadrant 16. Stelter also discusses at column 4, lines 53-56, the use of a double-acting cylinder 56 so pressure may be provided on both sides of a piston to

raise and lower the quadrant and rectify a portion of the live load. Stelter does not, however, disclose dual quadrants.

U.S. Patent No. 5,722,475, granted March 3, 1998, Lammi, discloses a design of ring type debarker using rotary cutting heads 23. The ring or rotor 4 can be varied in speed, as stated in the abstract, and in column 2, lines 60-63. The speed of the rotor disk 4 can be adjusted continuously due to variations in log diameter, surface finish, irregularities and the like. It is mentioned in column 2, lines 64-67, that the rotational speed of the cutting head should be kept nearly constant regardless of variations in the rotor speed. Lammi therefore does not disclose variable ring or rotor speed or variable force on the cutting blades.

U.S. Patent No. 4,609,020, granted September 2, 1986, Hutson, is one of several Hutson patents which disclose a log debarker system which has a rotor assembly 26 which uses a plurality of debarking tools 28 (knives), the combination rotating in a rotor housing assembly 24. There is no mention of varying the force on the debarking tools 28 or rotor or log feed speed as a function of diameter.

U.S. Patent No. 5,117,881, granted June 2, 1992, Simpson, assigned to Nicholson Manufacturing Company, discloses a ring type debarking apparatus which includes counterbalance weights 64 for rotary cutters 22. The counterbalance weights 64 offset centrifugal and gravitational forces. The debarker also includes rotary cutting units 18 on ends of swing arms 24. The debarker ring 22 rotates (see column 2, lines 8-9) but presumably at a constant speed. There is no mention of varying ring speed, tool tip force or log feed speed as a function of log diameter.

U.S. Patent No. 4,330,019, granted May 18, 1982, Murphy et al., discloses a sawmill for cutting logs into lengths which allows for maximum use of the wood. An electronic scanner surveys the log as it is delivered to a support and obtains log profile data which is transmitted to a computer. Signals sent by the computer to each of the saws cause the saws to take up positions which ensure that the log is cut into optimum random lengths. The Murphy et al. system utilizes a reference datum line or cutting plane (see column 1, lines 55-56) for positioning the log. Murphy et al. disclose a "reach out" cylinder 126 and an end plate, but these are used to assess the position of the butt end of the log and do not push the log into any particular position. The log therefore remains in its initial rest position.

Murphy et al. also disclose a scanner 100 which may use conventional single or double axis techniques for scanning (see column 4, lines 28-29) as well as a master control unit 110.

U.S. Patent No. 4,468,993, granted September 4, 1984, McCown et al., discloses a log bucking station in which a log is scanned to determine its size and shape. The scan data is analyzed by a computer which determines the optimum locations for cuts on the log. The proposed cut locations are optically displayed on the log by a laser for inspection by the operator. The operator can overrule the computer. McCown et al. permit the distance between the pairs of saws to be varied because the saws run on tracks. By varying the distance between the two travelling saws 26 and 28, it is said that it is possible to optimize the saw cut locations.

SUMMARY OF INVENTION

The present invention overcomes or greatly reduces the disadvantages of known systems for processing raw logs into debarked random cut lengths prior to delivery of the logs to a chipping or log sawing apparatus.

The invention is directed to a log processing and cutting system comprising: (a) a log infeed deck; (b) a log feeder; (c) a dual quadrant singulator located downstream of the log feeder; (d) an infeed conveyor; (e) a log barker located downstream of the barker infeed conveyor; (f) a barker outfeed conveyor located downstream of the log debarker; (g) a bucking line scanner which scans the debarked log and by means of an associated computer, determines the log profile of the debarked log and determines optimum cutting locations on the log; (h) a conveyor located downstream of the bucking line scanner for conveying the scanned log to a bucking line; (i) a cradle in which the scanned log is held; (j) a bucking line positioner which contacts an end of the scanned log and moves it to an optimum position for cutting by a cut-off saw; (k) a bucking line cut-off saw which cuts the log at the optimum location determined by the computer from the log profile information ascertained by the scanner; (l) a bucking line outfeed conveyor located downstream of the cut-off saw for conveying away the cut log; and (m) a log sorter which directs the cut log to a log sorting station.

The dual quadrant singulator can comprise a lower quadrant singulator and an upper quadrant singulator, the pair of singulators operating in combination to single out and elevate individual logs.

The debarker can incorporate rotating rings, which can hold debarking knives and the force exerted on the cutting knives and the speed of rotation of the rings can be varied according to log profile characteristics of an individual log. The bucking line scanner can determine the log profile by three laser scans, to determine the volume and shape of the log being scanned at incremental log lengths.

The computer can instruct the cut-off saw to move in advance of the log reaching the cradle in order to minimize saw travel during the log cutting operation. The log positioner can comprise a hydraulic piston and cylinder, the piston extending a specified distance as determined by the computer, based on log profile and volume data as determined by the log scanner, and thereby positioning the log in optimum position.

The system can include a pair of spaced apart cut-off saws, the locations of the pair of cut-off saws being variable according to optimum saw location cut points on the log to be cut, as determined by the computer based on log scan data determined by the scanner.

The invention is also directed to a method of processing and cutting logs comprising: (a) singulating logs using a dual quadrant singulator; (b) debarking the logs using a variable speed ring and knife system; (c) scanning the debarked log by means of an associated computer, which determines the log profile of the debarked log and determines optimum cutting locations on the log; (d) conveying the scanned log to a bucking line cradle; (e) using a bucking line positioner which contacts an end of the scanned log and moves it to an optimum position for cutting; (f) cutting the log at the optimum locations as determined by the computer from the log profile information ascertained by the scanner and according to the positioner; (g) conveying the cut log away from the cutting area; and (h) sorting the cut log according to a command from the computer.

The dual quadrant singulator can comprise a lower quadrant singulator which can lift the log to a first elevation and an upper quadrant singulator, which can lift the log to a second elevation. The rotating rings of the

debarker can hold cutting knives and the force exerted by the cutting knives on the log and the speed of rotation of the rings can be varied according to log profile characteristics of an individual log.

The scanning of the log can be done by three laser scans, which determine the volume and shape of the log being scanned at incremental log lengths. A computer can command a saw to move in advance of the log reaching the cradle to thereby minimize saw travel during the log cutting operation. The log can be positioned in the cradle by a piston which can extend a specified distance as determined by the computer, based on log profile and volume data as determined by the log scanner, and thereby positioning the log in optimum position. The log can be cut at two locations, the locations of the cuts being determined as optimum by the computer based on log scan data ascertained by the scanner.

BRIEF DESCRIPTION OF DRAWINGS

In drawings which illustrate specific embodiments of the invention, but which should not be construed as restricting the spirit or scope of the invention in any way:

Figure 1 is a schematic plan of the log processing mill showing the general arrangement and sequence of the log processing equipment and process.

Figure 2 is a detail schematic plan of the quadrant/barker area showing the general arrangement of the log singulating and debarking equipment.

Figure 3 is an end elevation of the dual log quadrant feeder.

Figure 4 is a schematic plan of the cut-off-saw bucking area showing the general arrangement of the log handling, sawing and cut log conveying and sorting equipment.

Figure 5 is an end elevation of the cut-off saw and log bucking cradle.

Figures 6a, 6b and 6c are plan, side and end elevations of the cut-off saw area log positioner.

Figure 7 is an end section view of the raw log collecting and dual quadrant area, taken along section line 1 of Figure 1.

Figure 8 is an end section view of the dual side by side log barkers, taken along section line 2 of Figure 1.

Figure 9 is an end section view of the dual and cut log take away deck, taken along section line 3 of Figure 1.

Figure 10 is a schematic of the computer monitor display showing scanned log profile form the scanner.

Figure 11 is a schematic of the computer monitor display showing variables of the log bucking system.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS OF THE LOG PROCESSING MILL

A log handling and cutting system which cuts logs into lengths, and allows for maximum use of fiber is disclosed. The system includes equipment for singulating the logs, optimally removing the bark from the logs, scanning the true log image, cutting the logs to length, and sorting the cut logs arranged in a sequence of coupled operations. The logs are singulated using a dual quadrant singulation system to provide maximum singulation reliability, thereby allowing a single operator to attend to this process. Once singulated, the logs are fed automatically into a debarker where the diameter and volume are scanned and debarker-operating parameters are set for optimum bark removal. The log is then scanned, tree length, using a unique scanning system, which determines the true image of the log. This enables the determination by computer of the optimum bucking solution of the log as well as a proper sorting of the optimum random lengths. The saws are adjusted in response to the computer solution and the log is positioned by a positioner according to a computer generated reference datum. This results in the log being positioned for cutting to the optimum random lengths. A command signal is sent from the computer to the log sorting system, which tracks the position of the random lengths and allows them to be sorted to the appropriate sort storage bin.

This subject invention optimizes the debarking of the logs by using input variables of log diameter, tool overlap, tool speed (SFPM - surface feet per minute), and required tool tip force to determine the debarker feedspeed, debarker ring RPM and the applied pressure to the debarker tools (PSI). The applied pressure calculation takes into account the effects of centripetal acceleration on the tool arms at a given log diameter to ensure that the correct and optimum pressure is applied to debarking tools.

In the system according to the invention, the logs are first singulated from a log pile using a dual quadrant feed arrangement which enables high log handling rates with minimal intervention by an attendant. Once singulated, the log is fed automatically in a variable speed ring style debarker where log diameter information is collected and the debarking procedure is optimized for tool overlap, feedspeed, ring RPM, and tool pressure. This combination minimizes cutting overlap and wasted white wood. This debarking process is adjusted dynamically by a computer as the log diameter is changed down the log length (since logs are not perfect cylinders). After debarking, the log is scanned over its entire tree length on a belt with a triple combination scanner. This scanner system calculates the log length, log volume and the true shape cross-section of the log down its length thereby generating a true shape image of the log. This data includes sweep, taper, crooks and other log imperfections. This data is then transmitted to an optimizing computer, which rapidly analyzes the data and determines the optimum cut locations. The debarked and scanned log is then transferred transversely to a queuing cradle and then into a cut cradle. As soon as the log reaches the cut cradle, a unique log positioner locates the end of the log in relation to the moveable saw positions and pushes the log into optimum position for cutting. Once the log is cut, the cut portions are taken away and the saws are able to move to their next required position, while a new log is being transferred to the cut cradle. The log that has been cut into sections is unloaded onto a conveyor belt and is transferred to the cut piece sorting area. While this transfer is being performed, the new log is being cut. This overlap of infeed, cutting and outfeed cycles reduces log handling time and allows a smooth and efficient process to be performed in the log cut-off saw area of the system.

Referring to the drawings, Figure 1 illustrates a schematic plan of the overall log processing system and equipment including the general arrangement and sequence of the log processing equipment from the raw log collection area to the